

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference DN199911PCT	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/US 99/11772	International filing date (day/month/year) 28/05/1999	(Earliest) Priority Date (day/month/year)
Applicant THE GOODYEAR TIRE&RUBBER COMPAGNY et, al		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1

☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PC 99/11772

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F16F 05 B60G11/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F16F B60G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 326 082 A (ROBBINS MATTHEW A ET AL) 5 July 1994 (1994-07-05) figures 1,2	1,2,7
Y	US 5 535 994 A (SAFREED JR CARL K) 16 July 1996 (1996-07-16) the whole document	1,2,7
A	US 4 733 876 A (HEIDER DALE J ET AL) 29 March 1988 (1988-03-29) figures 5,6	1,2,5
A	PATENT ABSTRACTS OF JAPAN vol. 009, no. 055 (M-362), 9 March 1985 (1985-03-09) & JP 59 190533 A (SUMITOMO DENKI KOGYO KK), 29 October 1984 (1984-10-29) abstract	1,6,7
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

10 January 2000

Date of mailing of the international search report

17/01/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
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Authorized officer

Tsitsilonis, L

INTERNATIONAL SEARCH REPORT

International Application No

PC 99/11772

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 306 040 A (TAURUS GUMIIPARI VALLALAT) 8 March 1989 (1989-03-08) figure 5 ---	1,8
A	US 2 977 134 A (HELLING, J.) 28 March 1961 (1961-03-28) figures 2-4 ---	1,9
A	US 3 790 147 A (OWEN R) 5 February 1974 (1974-02-05) figure 2 ---	1,9
A	EP 0 123 171 A (FIRESTONE TIRE & RUBBER CO) 31 October 1984 (1984-10-31) figures 1-3 ---	1
A	EP 0 295 392 A (FIRESTONE TIRE & RUBBER CO) 21 December 1988 (1988-12-21) figure 1 ---	1
A	EP 0 590 317 A (BRIDGESTONE FIRESTONE INC) 6 April 1994 (1994-04-06) figure 1 ---	1
A	US 5 467 971 A (HURTUBISE DIANE M ET AL) 21 November 1995 (1995-11-21) column 5, line 17 - line 63; figures -----	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PC 99/11772

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5326082	A	05-07-1994	JP 6026544 A	01-02-1994
US 5535994	A	16-07-1996	CA 2117051 A	31-05-1995
US 4733876	A	29-03-1988	CA 1273967 A	11-09-1990
JP 59190533	A	29-10-1984	NONE	
EP 0306040	A	08-03-1989	HU 207382 B	29-03-1993
			AT 75530 T	15-05-1992
			CS 8805857 A	12-09-1990
			DE 3870550 A	04-06-1992
			HR 931014 A	30-04-1996
			SI 8811623 A,B	30-04-1996
			SU 1642959 A	15-04-1991
			US 5024424 A	18-06-1991
US 2977134	A	28-03-1961	FR 1210944 A	11-03-1960
			GB 847324 A	
US 3790147	A	05-02-1974	NONE	
EP 0123171	A	31-10-1984	US 4564177 A	14-01-1986
			AU 585749 B	22-06-1989
			AU 1469888 A	21-07-1988
			AU 574068 B	30-06-1988
			AU 2632284 A	25-10-1984
			BR 8401847 A	27-11-1984
			CA 1216601 A	13-01-1987
			DE 3475216 A	22-12-1988
			JP 1829024 C	15-03-1994
			JP 5031691 B	13-05-1993
			JP 59200831 A	14-11-1984
			MX 159175 A	27-04-1989
			NZ 207730 A	06-03-1987
EP 0295392	A	21-12-1988	US 4787606 A	29-11-1988
			AU 606414 B	07-02-1991
			AU 1534288 A	22-12-1988
			CA 1307799 A	22-09-1992
			DE 3864453 A	02-10-1991
			JP 2825494 B	18-11-1998
			JP 63318334 A	27-12-1988
EP 0590317	A	06-04-1994	US 5342139 A	30-08-1994
			BR 9303958 A	05-04-1994
			CA 2107247 A	31-03-1994
			DE 69322465 D	21-01-1999
			DE 69322465 T	29-04-1999
			JP 6193619 A	15-07-1994
US 5467971	A	21-11-1995	NONE	

PATENT COOPERATION TREATY

EO/US
PCT/US99/11772

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE
in its capacity as elected Office

Date of mailing:

07 December 2000 (07.12.00)

International application No.:

PCT/US99/11772

Applicant's or agent's file reference:

DN1999119PCT

International filing date:

28 May 1999 (28.05.99)

Priority date:

Applicant:

TROWBRIDGE, Mark, Guy

1. The designated Office is hereby notified of its election made:



in the demand filed with the International preliminary Examining Authority on:

27 March 2000 (27.03.00)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was



was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer:

J. Zahra

Telephone No.: (41-22) 338.83.38

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

C. J. J.
10/30/00

PCT

To:

KRAWCZYK, Nancy T.
The Goodyear Tire & Rubber Company
Dept 823
1144 East Market Street
Akron, Ohio 44316-0001
ETATS-UNIS D'AMERIQUE

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing
(day/month/year) 13.10.2000

Applicant's or agent's file reference
DN199911PCT 119

IMPORTANT NOTIFICATION

International application No.
PCT/US99/11772

International filing date (day/month/year)
28/05/1999

Priority date (day/month/year)
28/05/1999

Applicant
THE GOODYEAR TIRE & RUBBER COMPAGNY et, al

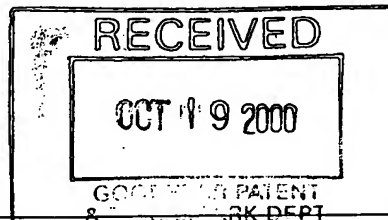
1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.



Name and mailing address of the IPEA/

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Authorized officer

Murphy-Minehane, B

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference DN199911PCT	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US99/11772	International filing date (day/month/year) 28/05/1999	Priority date (day/month/year) 28/05/1999
International Patent Classification (IPC) or national classification and IPC F16F9/05		
Applicant THE GOODYEAR TIRE&RUBBER COMPAGNY et,al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.


2. This REPORT consists of a total of 6 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 8 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 27/03/2000	Date of completion of this report 13.10.2000
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Alfaro Martinez, J Telephone No. +49 89 2399 7337



**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/US99/11772

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

4	as originally filed			
1, 1a, 2, 2a, 3, 5	as received on	21/08/2000	with letter of	16/08/2000

Claims, No.:

1-8	as received on	21/08/2000	with letter of	16/08/2000
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Drawings, sheets:

1/4-4/4	as originally filed
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2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US99/11772

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 5-7
	No:	Claims 1-4, 8
Inventive step (IS)	Yes:	Claims
	No:	Claims 1-8
Industrial applicability (IA)	Yes:	Claims 1-8
	No:	Claims

2. Citations and explanations

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Reference is made to the following document:

D1: US-A-4 733 876

D2: EP-A-0 295 392

D3: US-A-5 535 994

2. The document D1 discloses an airspring (D1 fig. 5, 6) for absorbing and transmitting shock loads between parts moveable relative to one another, the airspring comprising a flexible cylindrical sleeve (46) which is secured at each end to form a fluid chamber (48) therein, a piston, the sleeve being secured at one end to a retainer, said retainer having a ribbed reinforcement structure to strengthen the retainer with a plurality of extending ribs (34) allowing for direct mounting of the airspring to one of the movable parts. Said ribbed reinforcement structure is regarded as being "intermediate" because it is located between the airspring and the vehicle frame.
3. The observations in the applicants letter of 16/08/2000 have been considered but are not agreed with for the following reasons: Claim 1 fails to disclose in more detail exactly with respect to what parts or features the ribbed structure is considered intermediate. Furthermore, claim 1 states (line 8) that the retainer has a ribbed structure allowing for direct mounting of the airspring to one of the moveable parts, as does the airspring in D1, but it does not disclose that the structure is an integral part of the retainer.

The document D1 therefore includes all the features of claims 1 and 2. Thus, the subject-matter of independent claim 1 and of claim 2 is not novel (Article 33(2) PCT).

4. The additional feature of claim 3, insofar as this claim can be understood (see section VIII), is also known from D1 (fig. 5), wherein one of the ribs could be said to extend "the full width of the structure" (the upper-most rib in Fig. 6 when measured either perpendicular to the paper plane or from top to bottom). Therefore the subject-matter of claim 3 is considered not novel (Article 33(2) PCT).
5. The additional feature of claim 4 is also known from D1 (see fig. 5 and 6), which shows two sets of ribs extending at angles relative to each other. Consequently, the subject-matter of claim 4 is not novel (Article 33(2) PCT).
6. It is known from D2 (col 2, lines 26-30) to use "plastic or similar materials" for the retainer. On the basis of this information it would be an obvious design measure for the skilled person to use thermoplastics (claim 5) or any of the equivalent materials of claim 6.

Moreover, the broad strength requirements defined in claim 6 merely appear to be what the skilled person would arrive at using routine development, and without involving any surprising or special technical effects.

Therefore, the subject-matter of claims 5 and 6 does not involve an inventive step and does not satisfy the criterion set forth in Article 33(3) PCT.

7. It is known from D3 (col 2, lines 26-30, Figure 1) to use an air inlet (25) that extends through the upper retainer (21). The skilled person would regard it a normal design procedure to include an air inlet through the upper retainer to inflate the pneumatic sleeve in an air spring assembly, regardless of whether the retainer is reinforced or not. Thus, the subject-matter of claim 7 does not involve an inventive step and does not satisfy the criterion set forth in Article 33(3) PCT.

8. In Fig. 6 of D1 the upward and downward directions in the paper plane could be regarded as "outer" and "inner" directions, respectively. Thus, the vertical plate could constitute an "outer" plate, the horizontal an "inner" plate and the triangular plates a plurality of ribs, all as defined in claim 8. Consequently, insofar as this claim can be understood (see Section VIII, 2), the subject-matter of claim 8 is not novel (Article 33(2) PCT).

Re Item VIII

Certain observations on the international application

1. Claim 3 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined. Without a detailed definition of the shape and arrangement of the reinforcement structure in claim 3 (or in any preceding claim), it can not be determined how "width" is to be measured and consequently it is unclear how the ribs are to extend "the full width" of the structure.
2. In claim 8 it is not clear with respect to what references the two plates are to be regarded as being "inner" and "outer", respectively.

DN1999119PCT

- 1 -

AIR SPRING UPPER RETAINER**Field of the Invention**

The present invention is directed toward a retainer for an air spring. More particularly, the present invention is a thermoplastic upper retainer for an air spring which provides for easy air spring assembly and mounting.

Background of the Invention

Air springs have been used for motor vehicles and various other machines and equipment for a number of years. The springs provide cushioning between movable parts, primarily to absorb shock loads imparted thereon. The air spring consists of at least one flexible elastomeric reinforced sleeve extending between a pair of retainers, forming a pressurized chamber therein. The sleeve typically has a relatively inextensible bead core at each end for securing the sleeve to the retainers. Alternatively, the sleeve may be secured to the retainers by conventional crimping means. There may be one or more pistons associated with the air spring. The retainers also assist in securing the air spring on spaced components or parts of the vehicle or equipment by being secured to a mounting plate which is attached to the moveable part of the vehicle or machine.

The fluid in the pressurized chamber, generally air, absorbs most of the shock impressed upon or experienced by one of retainers. The retainers move towards and away from each other when the air spring is subjected to any forces.

Both upper and lower retainers are conventionally formed of stamped metal. If the air spring has a piston, the piston, upon which the lower retainer is secured, may be metal or thermoplastic. A bumper, mounted on either retainer and provided for impact absorption and transference, is usually thermoplastic or thermoelastic, depending upon the forces which will ultimately be acting on the air spring and the forces to which the bumper will be subjected.

When the air spring is mounted to a vehicle, a subassembly made from coated steel stampings and plumbing components are used to achieve the mounting attachment, air connection and airsleeve bead captivation. Such conventional mounting means are illustrated in the following U.S. patents: 5,203,585; 5,464,245; 5,403,031, 5,346,247, and 4,733,876 (which has a two material upper retainer which has a mounting structure rising from two cojoined flat plates). Other known air springs and retainers are disclosed by US 5,535,994 and EP 295,392.

- 1a -

Summary of the Invention

The present invention is directed toward providing a lightweight, low cost means of easily attaching the air supply end of the air spring directly to a suspension frame rail of a vehicle.

- 2 -

The present invention is an improved air spring for absorbing and transmitting shock loads between parts moveable relative to one another. The air spring comprises a flexible cylindrical sleeve which is secured at each end to form a fluid chamber therein. One end of the sleeve is secured to a retainer. The retainer has a ribbed reinforcement structure which allows for direct mounting of the airspring to one of the moveable parts.

The ribbed reinforcement structure of the disclosed retainer is comprised of a plurality of ribs. In an alternative construction, the ribs may run the full length of the reinforcement structure. The ribs may also be at least two sets of ribs, with the ribs extending at different angles relative to each other.

The disclosed retainer has an axially extending mounting plate for directly mounting the air spring to the moveable part.

The disclosed retainer also has a bead seating surface. The bead seating surface is adjacent to the ribbed reinforcement structure.

The disclosed retainer is formed from a thermoplastic material having a tensile strength in the range of 1965 to 3165 kg/cm² (28,000 to 45,000 psi), and a flex strength in the range of 2810 to 4220 kg/cm² (40,000 to 60,000 psi).

Brief Description of the Drawings

The invention will be described by way of example and with reference to the accompanying drawings in which:

FIG. 1 is a half cross-sectional view of an air spring with the inventive upper retainer;

FIG. 2 is a perspective view of the inventive retainer;

FIG. 3 is a side view of the upper retainer;

FIG. 4 is a top view of the retainer;

FIG. 5 is a bottom view of the retainer; and

FIG. 6 is a cross-section view of the retainer through line 6-6 of FIG. 3.

Detailed Description of the Preferred Embodiments

The present invention is illustrated within an assembled air spring 1 in FIG. 1. The air spring 1 has a cylindrical elastomeric sleeve 2. The elastomeric sleeve 2 is preferably comprised of at least 3 plies: an outer elastomeric ply 3, at least one reinforcing ply 4 formed of elastomeric embedded reinforcing cords, and an inner elastomeric ply 5. The upper end 6 of the sleeve 2 has a relatively inextensible bead 7

- 2a -

for securing the airsleeve 2 to the inventive upper retainer 8. The bead core 7 is at least one continuous winding of wire, preferably steel. The configuration of the bead core 7

- 3 -

may vary as is conventionally known. The lower end 9 of the airsleeve 2 may also be defined by a bead core 10 for securing the lower end 9 of the airsleeve 2.

The lower end 9 of the airsleeve 2 is secured to a piston 11. The lower end 9 of the airsleeve 2 may be secured in any conventional manner, including, but not limited to, crimping the lower end 9 of the airsleeve 2 to the piston or to a conventional lower retainer or by securing the bead core 10 by a lower retainer. An internal bumper may be provided for absorbing impact forces. When the air spring 1 is in use, the upper retainer 8 moves in an axial direction and the sleeve 2 travels up and down the outside of the piston 10.

The inventive upper retainer 8, seen illustrated in FIGS 2 to 6, is a unitary article, provided with both bead seating means 12 and mounting means 13. The underside of the retainer 8 is defined by the bead seating surface 12, see FIG. 3. At the axially innermost edge of the bead seating surface 12, relative to the air chamber 14 formed within the air spring 1, is a bead retention lip 15. The bead retention lip 15 has a radial width of at most 10 mm, and is preferably in the range of 2 mm to 6 mm. The width of the bead retention lip 15 is greater than zero to prevent the bead 7 from dismounting and disengaging from the retainer 8 under low-pressure operation of the air spring 1. If the bead retention lip 15 has a radial dimension greater than 10 mm, then the bead 7 cannot be press-fitted onto the retainer 8 without damage to either the airsleeve 2 or the bead 7 due to the highly inextensible nature of the bead. In mounting the bead 7 to the retainer 8, the bead 7 is held onto the retainer 8 by the interference fit between the bead seating surface 12 and the air spring bead 7 to effect a seal. The radius of the bead seating surface 12 is less than the greatest radius of the retainer 8, but greater than the radius of the air spring bead 7.

The intermediate reinforcement section 16 of the air spring retainer 8 is defined by a plurality of ribs 17 which extend the length or width of the intermediate reinforcement section 16 of the retainer 8. The ribs 17 are located between the outer plate 18 and the inner plate 19. A preferred embodiment of the ribs 17 is illustrated in FIGS. 2, 3 and 6. As seen most clearly on FIG. 6, the ribs 17 extend the full length of the outer and inner plates 18,19. The ribs 17 are substantially equal in width and are equidistant from each other, forming equiwidth cavities. The ribs 17 are blended at the point of connection with the upper and lower plates 18,19. Also between the two plates 18,19 are two ribs 20 which extend perpendicular to the plurality of ribs 17. These perpendicular ribs 20 assist in providing structural support to the retainer 8.

- 5 -

provided with at least one mounting hole 26. The holes 26 are reinforced with steel inserts 27 to strengthen the mounting of the air spring 1.

5 The retainer 8 is injection molded from a resilient material, preferably thermoplastic. Examples of applicable material include, but are not limited to, fiberglass reinforced nylon, long fiber reinforced thermoplastic, commercially available as CELSTRAN, and short fiber reinforced thermoplastic, commercially available as ZYTEL. The tensile strength of the material should be within the range of 1965 to 3165 kg/cm² (28,000 to 45,000 psi), have a flex strength in the range of 2810 to 4220 kg/cm² (40,000 to 60,000 psi), and notched izod strength of 0.117 – 0.703 N-m/mm (2.0 to 12.0
10 ft-lb/in).

Variations in the present invention are possible in light of the description of it provided herein. While certain representative embodiments and details have been shown for the purpose of illustrating the subject invention, it will be apparent to those skilled in this art that various changes and modifications can be made therein without departing
15 from the scope of the subject invention. It is, therefore, to be understood that changes can be made in the particular embodiments described which will be within the fully intended scope of the invention as defined by the following appended claims.

- 6 -
CLAIMS

1. An air spring (1) for absorbing and transmitting shock loads between parts moveable relative to one another, the air spring (1) comprising a flexible
5 cylindrical sleeve (2) which is secured at each end to form a fluid chamber (14) therein, a piston (11), the sleeve (2) being secured at one end (6) to a retainer (8), the air spring being characterized by:
the retainer (8) having an intermediate ribbed reinforcement structure (16)
to strengthen the retainer, allowing for direct mounting of the air spring (1) to one
10 of the moveable parts.
2. An air spring (1) in accordance with claim 1 wherein the retainer is further characterized by the intermediate ribbed reinforcement structure (16) comprising a plurality of extending ribs (17 or 20).
15
3. An air spring (1) in accordance with claim 2 wherein the retainer is further characterized by the ribs (17 or 20) extending the full width of the intermediate reinforcement structure (16).
- 20 4. An air spring (1) in accordance with claim 1 wherein the intermediate ribbed reinforcement structure (16) is further characterized by two sets of ribs (17 or 20) extending at angles relative to each other (20 or 17).
5. An air spring (1) in accordance with claim 1 wherein the retainer (8) is further
25 characterized by being formed from a thermoplastic material having a tensile strength in the range of 1965 to 3165 kg/cm² (28,000 to 45,000 psi), and a flex strength in the range of 2810 to 4220 kg/cm² (40,000 to 60,000 psi).
6. An airspring (1) in accordance with claim 5 wherein the retainer (8) is further
30 characterized by being formed from a material selected from the following group: fiberglass reinforced nylon, long fiber reinforced thermoplastic, and short fiber reinforced thermoplastic.

- 7 -

7. An air spring (1) in accordance with claim 1 wherein the retainer (8) is further characterized by air inlet means (21, 23) that extends through the intermediate ribbed reinforcement structure (16).

5

8. An air spring (1) in accordance with claim 1 wherein the intermediate ribbed reinforcement structure (16) of the retainer (8) is further characterized by an outer plate (18) and an inner plate (19), and a plurality of ribs (17 or 20) which extend between the outer plate (18) and the inner plate (19).

10

PATENT COOPERATION TREATY

JAN 24 2000

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT OR THE DECLARATION

(PCT Rule 44.1)

To:

The Goodyear Tire & Rubber Company
Dept 823
Attn. KRAWCZYK, Nancy T.
1144 East Market Street
Akron, Ohio 44316-0001
UNITED STATES OF AMERICA

Date of mailing
(day/month/year)

17/01/2000

Applicant's or agent's file reference

DN199911PCT 119

FOR FURTHER ACTION

See paragraphs 1 and 4 below

International application No.

PCT/US 99/ 11772

International filing date
(day/month/year)

28/05/1999

Applicant

THE GOODYEAR TIRE&RUBBER COMPAGNY et, al

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Fascimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority



European Patent Office, P.B. 5818 Patentaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Brigitta Klág

JAN 25 2000

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

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ART 34 ADT

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Rec'd PCT/PTO 06 NOV 2001
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PCT/US99/1772

- 1 -

AIR SPRING UPPER RETAINER

Field of the Invention

The present invention is directed toward a retainer for an air spring. More particularly, the present invention is a thermoplastic upper retainer for an air spring which provides for easy air spring assembly and mounting.

Background of the Invention

Air springs have been used for motor vehicles and various other machines and equipment for a number of years. The springs provide cushioning between movable parts, primarily to absorb shock loads imparted thereon. The air spring consists of at least one flexible elastomeric reinforced sleeve extending between a pair of retainers, forming a pressurized chamber therein. The sleeve typically has a relatively inextensible bead core at each end for securing the sleeve to the retainers. Alternatively, the sleeve may be secured to the retainers by conventional crimping means. There may be one or more pistons associated with the air spring. The retainers also assist in securing the air spring on spaced components or parts of the vehicle or equipment by being secured to a mounting plate which is attached to the moveable part of the vehicle or machine.

The fluid in the pressurized chamber, generally air, absorbs most of the shock impressed upon or experienced by one of retainers. The retainers move towards and away from each other when the air spring is subjected to any forces.

Both upper and lower retainers are conventionally formed of stamped metal. If the air spring has a piston, the piston, upon which the lower retainer is secured, may be metal or thermoplastic. A bumper, mounted on either retainer and provided for impact absorption and transference, is usually thermoplastic or thermoelastic, depending upon the forces which will ultimately be acting on the air spring and the forces to which the bumper will be subjected.

When the air spring is mounted to a vehicle, a subassembly made from coated steel stampings and plumbing components are used to achieve the mounting attachment, air connection and airsleeve bead captivation. Such conventional mounting means are illustrated in the following U.S. patents: 5,203,585; 5,464,245; 5,403,031, and 5,346,247. The present invention provides for a single molded part to achieve all of these functions.

Summary of the Invention

The present invention is directed toward providing a lightweight, low cost means of easily attaching the air supply end of the air spring directly to a suspension frame rail of a vehicle.

The present invention is an improved air spring for absorbing and transmitting shock loads between parts moveable relative to one another. The air spring comprises a flexible cylindrical sleeve which is secured at each end to form a fluid chamber therein. One end of the sleeve is secured to a retainer. The retainer has a ribbed reinforcement structure which allows for direct mounting of the airspring to one of the moveable parts.

The ribbed reinforcement structure of the disclosed retainer is comprised of a plurality of ribs. In an alternative construction, the ribs may run the full length of the reinforcement structure. The ribs may also be at least two sets of ribs, with the ribs extending at different angles relative to each other.

The disclosed retainer has an axially extending mounting plate for directly mounting the air spring to the moveable part.

The disclosed retainer also has a bead seating surface. The bead seating surface is adjacent to the ribbed reinforcement structure.

The disclosed retainer is formed from a thermoplastic material having a tensile strength in the range of 28,000 to 45,000 psi, and a flex strength in the range of 40,000 to 60,000 psi.

Brief Description of the Drawings

The invention will be described by way of example and with reference to the accompanying drawings in which:

FIG. 1 is a half cross-sectional view of an air spring with the inventive upper retainer;

FIG. 2 is a perspective view of the inventive retainer;

FIG. 3 is a side view of the upper retainer;

FIG. 4 is a top view of the retainer;

FIG. 5 is a bottom view of the retainer; and

FIG. 6 is a cross-section view of the retainer through line 6-6 of FIG. 3.

Detailed Description of the Preferred Embodiments

The present invention is illustrated within an assembled air spring 1 in FIG. 1. The air spring 1 has a cylindrical elastomeric sleeve 2. The elastomeric sleeve 2 is preferably comprised of at least 3 plies: an outer elastomeric ply 3, at least one reinforcing ply 4 formed of elastomeric embedded reinforcing cords, and an inner elastomeric ply 5. The upper end 6 of the sleeve 2 has a relatively inextensible bead 7 for securing the airsleeve 2 to the inventive upper retainer 8. The bead core 7 is at least one continuous winding of wire, preferably steel. The configuration of the bead core 7

may vary as is conventionally known. The lower end 9 of the airsleeve 2 may also be defined by a bead core 10 for securing the lower end 9 of the airsleeve 2.

The lower end 9 of the airsleeve 2 is secured to a piston 11. The lower end 9 of the airsleeve 2 may be secured in any conventional manner, including, but not limited to, crimping the lower end 9 of the airsleeve 2 to the piston or to a conventional lower retainer or by securing the bead core 10 by a lower retainer. An internal bumper may be provided for absorbing impact forces. When the air spring 1 is in use, the upper retainer 8 moves in an axial direction and the sleeve 2 travels up and down the outside of the piston 10.

The inventive upper retainer 8, seen illustrated in FIGS 2 to 6, is a unitary article, provided with both bead seating means 12 and mounting means 13. The underside of the retainer 8 is defined by the bead seating surface 12, see FIG. 3. At the axially innermost edge of the bead seating surface 12, relative to the air chamber 14 formed within the air spring 1, is a bead retention lip 15. The bead retention lip 15 has a radial width of at most 10 mm, and is preferably in the range of 2 mm to 6 mm. The width of the bead retention lip 15 is greater than zero to prevent the bead 7 from dismounting and disengaging from the retainer 8 under low-pressure operation of the air spring 1. If the bead retention lip 15 has a radial dimension greater than 10 mm, then the bead 7 cannot be press-fitted onto the retainer 8 without damage to either the airsleeve 2 or the bead 7 due to the highly inextensible nature of the bead. In mounting the bead 7 to the retainer 8, the bead 7 is held onto the retainer 8 by the interference fit between the bead seating surface 12 and the air spring bead 7 to effect a seal. The radius of the bead seating surface 12 is less than the greatest radius of the retainer 8, but greater than the radius of the air spring bead 7.

The intermediate reinforcement section 16 of the air spring retainer 8 is defined by a plurality of ribs 17 which extend the length of the retainer 8. The ribs 17 are located between the outer plate 18 and the inner plate 19. A preferred embodiment of the ribs 17 is illustrated in FIGS. 2, 3 and 6. As seen most clearly on FIG. 6, the ribs 17 extend the full length of the outer and inner plates 18,19. The ribs 17 are substantially equal in width and are equidistant from each other, forming equiwidth cavities. The ribs 17 are blended at the point of connection with the upper and lower plates 18,19. Also between the two plates 18,19 are two ribs 20 which extend perpendicular to the plurality of ribs 17. These perpendicular ribs 20 assist in providing structural support to the retainer 8.

provided with at least one mounting hole 26. The holes 26 are reinforced with steel inserts 27 to strengthen the mounting of the air spring 1.

5 The retainer 8 is injection molded from a resilient material, preferably thermoplastic. Examples of applicable material include, but are not limited to, fiberglass reinforced nylon, long fiber reinforced thermoplastic, commercially available as
CELSTRAN, and short fiber reinforced thermoplastic, commercially available as
ZYTEL. The tensile strength of the material should be within the range of 28,000 to
45,000 psi, have a flex strength in the range of 40,000 to 60,000 psi, and notched izod
strength of 2.0 to 12.0 ft-lb/in.

10 Variations in the present invention are possible in light of the description of it
provided herein. While certain representative embodiments and details have been shown
for the purpose of illustrating the subject invention, it will be apparent to those skilled in
this art that various changes and modifications can be made therein without departing
from the scope of the subject invention. It is, therefore, to be understood that changes
15 can be made in the particular embodiments described which will be within the full-
intended scope of the invention as defined by the following appended claims.

CLAIMS

1. An improved air spring (1) for absorbing and transmitting shock loads between parts moveable relative to one another, the air spring (1) comprising a flexible
5 cylindrical sleeve (2) which is secured at each end to form a fluid chamber (14) therein, the sleeve (2) being secured at one end (6) to a retainer (8), the improvement being characterized by:
the retainer (8) having a ribbed reinforcement structure (16) allowing for direct mounting of the airspring (1) to one of the moveable parts.
10
2. An improved air spring (1) in accordance with claim 1 wherein the ribbed reinforcement structure (16) comprises a plurality of extending ribs (17 or 20).
3. An improved air spring (1) in accordance with claim 2 wherein the ribs (17 or 20)
15 extend the full length of the reinforcement structure (16).
4. An improved air spring (1) in accordance with claim 1 wherein the ribbed reinforcement structure (16) comprises at two sets of ribs (17 or 20) extending at angles relative to each other (20 or 17).
20
5. An improved air spring (1) in accordance with claim 1 wherein the retainer (8) has an axially extending mounting plate (24) for directly mounting the air spring (1) to the moveable part.
- 25 6. An improved air spring (1) in accordance with claim 1 wherein the retainer (8) is formed from a thermoplastic material having a tensile strength in the range of 28,000 to 45,000 psi, and a flex strength in the range of 40,000 to 60,000 psi.
7. An improved airspring (1) in accordance with claim 6 wherein the retainer (8) is
30 formed from a material selected from the following group: fiberglass reinforced nylon, long fiber reinforced thermoplastic, and short fiber reinforced thermoplastic.

8. An improved air spring (1) in accordance with claim 1 wherein the retainer (8) is comprised of a bead seating surface (12), the bead seating surface (12) being located adjacent the ribbed reinforcement structure (16).
- 5 9. An improved air spring (1) in accordance with claim 1 wherein the retainer (8) is comprised of air inlet means (21, 23) which extend through the ribbed reinforcement structure (16).